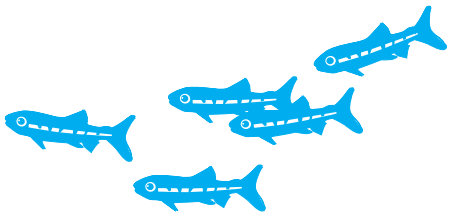
US Army Corps of Engineers
North Pacific Division

Salmon Passage Notes

Snake and Columbia River Fish Programs

November 1994

Surface-Oriented Bypasses for Juvenile Fish



A system for bypassing juvenile fish at the dams that would be more efficient, more fish-friendly, and possibly less costly than current systems, sounds too good to be true. Though it may turn out to be less than a perfect solution, scientists and engineers are optimistic that surface-oriented bypasses could prove to be an important part of long-term efforts to improve salmon survival at the dams.

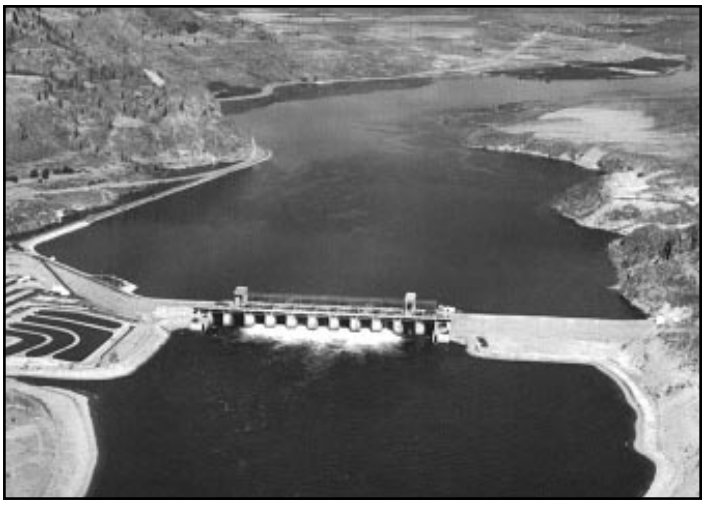
The concept is getting more and more notice lately. The Corps, in concert with other regional interests, is moving out on testing the concept at its lower Columbia and Snake River dams.

With juvenile bypass systems now in use at the dams, juvenile fish sound some 70 to 100 feet below the water's surface to find the turbine intake area—an experience that some biologists believe may delay or stress the fish. A surface-oriented system would guide migrating juvenile salmon in the top 20 to 30 feet of the reservoir surface where the juveniles typically travel as they approach the dams, and pass them through or over the dams.

Juvenile fish cue on water currents as they migrate from upriver rearing areas, past the lower Snake and Columbia River dams to the ocean where they will mature. When the powerhouses are operating, the flow of water into the turbine intakes creates a strong attraction for the fish as they approach the dams. Juveniles dive or "sound" to the turbine intake areas and attempt to pass the dams through that route. The surface-oriented bypass studies will investigate use of the turbine-created current to guide fish to the surface bypass, thus re-routing them before they sound down to the turbine intakes.

Currently, huge screens submerged in front of the turbine intake areas deflect many juveniles up away from the turbines and through bypass channels. One potential advantage of the surface oriented system is that, since the fish remain in the upper part of the reservoir, pressure changes and any resultant stress caused by diving and resurfacing could be avoided.

There are other potential benefits of surface bypass systems at the dams. They may be more efficient than the submerged screens at deflecting juveniles away from turbine intakes. The screens in the existing bypass systems have what is called "fish guidance efficiency" or "FGE" ranging from about 30 percent to 90 percent. For example, at some projects the screens will typically deflect 30 percent of fall chinook juveniles away from the turbines. For steelhead, the FGE might be closer to 90 percent.



Although not directly adaptable for lower Snake/Columbia dams, the successful surface-oriented bypass system at Wells "hydro-combine" Dam on the Columbia River may provide useful information for Corps prototype tests. (Photo courtesy of Douglas County PUD)

Scientists and engineers are hopeful that surface-oriented bypass systems could have an overall fish guidance efficiency of up to 90 or 95 percent.

A surface-oriented system might also reduce migration delays observed in the reservoirs. There is evidence that juveniles linger in the reservoirs directly upstream of the dams in the forebays, perhaps searching for a route past the dams. The Corps will monitor this behavior and feed the information into design of prototype surface bypasses with the idea of minimizing delay.

One particularly promising aspect of surface-oriented bypasses is the ability to route collected fish directly through a channel or over a spillway without handling or delays. It is possible that a smaller volume of spill than used in current programs could move a larger percentage of fish safely past the dams. A smaller volume of spill would mean reduced levels of gas supersaturation—a side-effect of high spill that can be harmful to fish—and would leave more water available for power generation.

Other means of gas abatement will be tested in conjunction with prototype design and testing for the surface collector. Spillway and stilling basin modifications to determine how best to achieve reduced gas supersaturation are also being evaluated in a related study.

The Corps, with State, Tribal and other Federal agencies, contractors, individuals and other interested parties, is expediting work on design and construction of prototype surface collectors at selected lower Snake and Columbia River projects. Efforts kicked off in July with two brainstorming sessions that included representatives from these interests.

On October 14, the Corps briefed the Northwest Power Planning Council's Drawdown Committee on a proposed plan to develop prototypes, starting with The Dalles, Lower Granite and Bonneville Dams. An ambitious schedule includes testing of prototype surface-oriented bypasses at The Dalles and Lower Granite Dams in 1996 and 1997.

NATURAL RIVER DRAWDOWNS STUDIED

Remove the dams?

Recent issues of *Salmon Passage Notes* promised discussion of an idea from an Oregon Natural Resources Council report called "Damnable Dams" which called for removing, or not constructing, a number of dams in Oregon, Washington and Idaho.

The gist of the report was that some existing and planned dams are not needed, and should be removed, or not built, to improve or restore fish habitat.

As reported in a January 1994 issue of *Willamette Week* (a Portland, Oregon weekly newspaper) the draft report suggested removing, among others, the four lower Snake River projects—Lower Granite, Little Goose, Lower Monumental and Ice Harbor Dams. The final Oregon Natural Resources Council report released this summer no longer lists these four dams, but the idea of removing or breaching the dams and allowing the Snake River to flow naturally is still being discussed in regional forums in conjunction with ongoing reservoir drawdown studies.

Under the drawdown concept, reservoirs behind the dams would be drawn down substantially below normal operating levels during the juvenile salmon migration. The idea is to decrease the cross-sectional size of the reservoir thereby increasing the velocity of the river. Theoretically, this would speed juvenile migration downstream to the ocean, and increase survival rates.

The Corps System Configuration Study (SCS) is examining various alternatives for physically altering the lower Snake and Columbia river dams to improve salmon passage conditions. Drawdowns are among the alternatives being studied.

So far, preliminary conclusions in the SCS are that, of the reservoir drawdown options studied, only drawdowns to natural river level have the potential to achieve better salmon survival rates than those under current operations. If the region decides that reservoir drawdown is the preferred path for salmon restoration, the natural river level drawdown seems to be the option that would make the most sense biologically, given current technologies for fish bypass. If surface-oriented bypasses prove to be effective, the appeal of other drawdown options such as spillway crest level could increase.

Study expanded

In April the Corps released a draft report on the first phase of the SCS. Since then, the Corps has proposed expanding its natural river level drawdown evaluation beyond the two or 4 1/2 month natural river drawdown scenarios included in that report, to consider year-round natural river operation of lower Snake dams. Three options proposed for evaluation are:

1) construct bypasses to route the river around the dams;

2) create a controlled breach through each dam; or

3) remove the four dams.

According to the SCS Phase I report, the 4 1/2 month natural river level drawdown alternative would actually halt power generation, navigation and irrigation from the dams for about six to ten months of the year. This is because drafting the system down two feet a day to a total of 115 feet takes nearly 2 months, and refilling at the end of migration can take from five to 130 days depending on river flows.

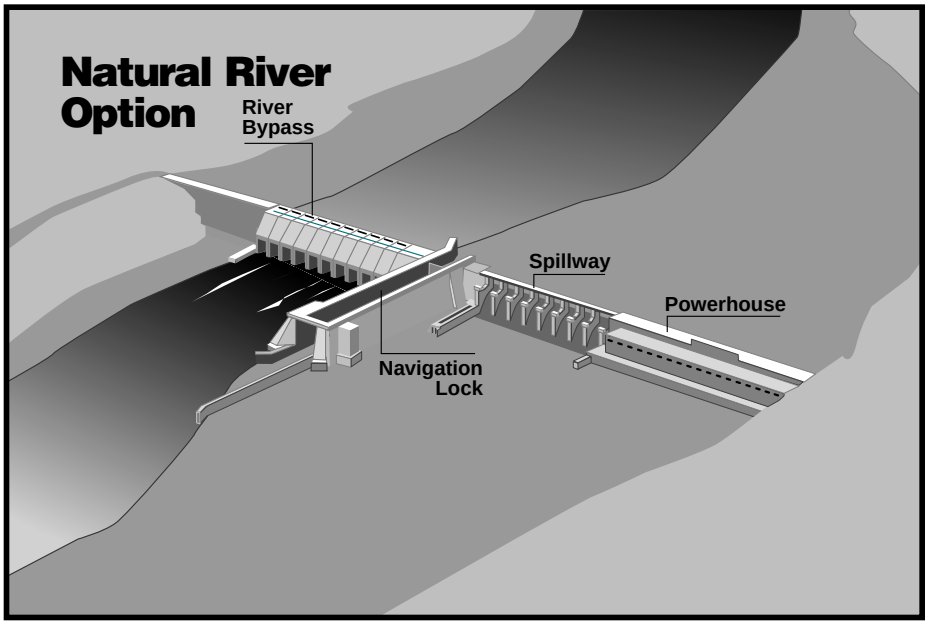
Drafting water levels up and down each year would prevent stabilization of exposed shore areas. A permanent natural river level operation would lessen impacts to fish and wildlife by allowing a stable shoreline and habitat to develop. The sediment stirred up in the river by a single drawdown would settle out more quickly than with repeated annual drawdowns, causing fewer negative effects for the salmon and other river life. Also, erosion from shoreline wave action would be reduced, lessening impacts to cultural resource sites.

In view of these factors, the Corps believes it is worthwhile to expand the current evaluation of drawdown alternatives to compare costs and effects of year-round natural river level drawdown options.

At a meeting of the Northwest Power Planning Council's Drawdown Committee in October, a Corps spokesman said that a preliminary look at the construction costs and schedule for a controlled breach of the dams revealed they could be somewhere around half of the $5 billion and 17 years estimated to modify the dams for a two or 4 1/2 month drawdown. There are no estimates yet available for the other two options.

As with a 4 1/2 month version, the year-round natural river level options would have significant direct effects in loss of power production, navigation, irrigation and recreation benefits, and would result in short-term loss of fish and wildlife habitat during construction and reestablishment of habitat. There would be economic impacts on the communities that depend on the health of agriculture, navigation and recreation industries.

But perhaps the biggest factor to be considered is lack of biological information on effects on salmon. While the region certainly seeks to have healthy rivers and wild salmon runs, there is uncertainty about whether a return to natural river level operation would bring back the salmon. Those who would be directly affected by such drastic action are asking, will it save the fish, and is it worth the potential risk and cost? All of us in the Northwest will be affected to some extent and will need to keep these questions in mind as the region considers the available alternatives for improving salmon survival.



Artist's conception of Natural River drawdown.

DAM REMOVAL—TWO PERSPECTIVES

Would the people of the Northwest miss the benefits provided by the four lower Snake River dams—Lower Granite, Little Goose, Lower Monumental and Ice Harbor—if they were to be shut down or removed?

In a January 1994 article in the *Idaho Salmon and Steelhead Unlimited*, Reed Burkholder of Boise, Idaho, suggests that these dams might be missed less than we would think. He states that:

1) the dams do not provide flood control

2) pumping stations on Ice Harbor Reservoir provide agricultural water for about 35,000 acres, but there are no irrigation canals to be affected;

3) the commercial navigation waterway was built and is maintained only at great cost to the public;

4) the four dams produce only about four to six percent of the Northwest energy supply which could probably be made up by use of other power sources; and

5) many of us would rather have healthy rivers and wild salmon runs than the power these four dams provide.

Salmon Passage Notes asked Ed Woodruff, a senior economist at the Corps North Pacific Division, to provide his perspective on the benefits and costs of the dams.

The numbers Woodruff cites from the Columbia River System Operation Review (SOR) draft Environmental Impact Statement (EIS) are from estimates of the effects of a 4 1/2 month natural river level drawdown of the four lower Snake River dams. The numbers would increase for a year-round natural river operation.

Woodruff agreed the four lower Snake River dams do not provide flood control. They are run-of-river dams, not intended to store water for flood control.

Of the four, only Ice Harbor Dam supplies irrigation water for agriculture, for about 36,000 acres of land. In the SOR draft EIS, the annual increased irrigation costs to farmers—to modify and maintain pumps, and pump water over a higher elevation—is estimated at about $4.6 million.

The dams do provide a significant stretch of navigable water from Lewiston, Idaho to the confluence with the Columbia River, and from there the lower Columbia River dams provide navigation to the ocean (a total distance of over 450 miles).

Burkholder reports that "the ports of Lewiston, Wilma and Clarkston annually ship about two million tons of goods, mostly wheat, at a savings over rail shipping of about $4.60 per ton" or $9.2 million total per year. He maintains the public pays for these benefits to barge operators in power and tax bills.

Burkholder estimates that in 1992 the public paid $27 million to operate and maintain the lower Snake dams; $8 million in Columbia/Snake channel dredging costs; $28 million for the Columbia River Juvenile Fish Program; and $7 million for the Lower Snake River Fish and Wildlife Compensation Program. He believes the public "takes a double hit because of the inland waterway" by subsidizing barge owners and losing salmon runs.

Woodruff would add other effects of navigation losses besides those in the Lewiston, Wilma and Clarkston area. As estimated in the SOR, approximately 4 million tons per year are barged through the lower Snake of which 3 million tons is grain (wheat and barley). The SOR estimates the increase in costs to transport by truck and rail at nearly $22 million annually for a 4 1/2 month drawdown.

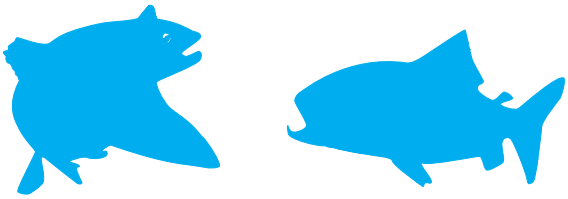
Woodruff states that of the $27 million to operate and maintain the dams in 1992, about $8 million is capital costs, such as replacing equipment. Over 80 percent of this is paid by ratepayers and amortized over multiple years. The remaining $19 million is an annual operating expense, of which $16 million is allocated to power generation and repaid by ratepayers.

The remaining $3 million is allocated to navigation. Barge companies pay a special fuel tax to the Inland Waterway Trust Fund for payment of half the costs of improvements to waterways projects. To the extent this tax does not represent full payment of operation and maintenance, navigation is subsidized. Dredging costs for the lower Snake portion of the Columbia/Snake waterway were around $3 million in 1992 but are typically lower and are paid by federal taxes.

Concerning power generation, in Fiscal Year 1993 (1 October 1992 to 30 September 1993) the four lower Snake River projects combined provided 9.8 million megawatt hours to the Pacific Northwest. This is about 5.6 percent of the regional requirement for 175 million megawatt hours. But the electricity generated at the dams is very cost effective when compared to the thermal alternatives that would have to be built and operated to provide an equivalent amount of power. According to the SOR draft EIS, a 4 1/2 month drawdown would increase annual power system costs by somewhere around $150 million, and cause an increase in Bonneville Power Administration wholesale rates.

The annual decrease to recreational benefits is estimated in SOR at up to $17 million, although this does not consider other recreational opportunities that might replace those created by the reservoirs and dams.

Fish and wildlife habitat would be disrupted initially under a natural river operation option, although a permanent drawdown allows reestablishment of habitat that is not possible under a 4 1/2 month drawdown. Disturbed sediment could initially pose problems for the salmon but would dissipate over time.



INTER-BASIN SALMON STUDY REPORT RELEASED

A new report that looks at a variety of salmon runs along the West Coast from Northern California to British Columbia and in the Columbia Basin, concludes that ocean conditions have had a "marked impact" on salmon numbers.

The Inter-Basin Comparison Study phase II analysis comparing Columbia River salmon production to other West Coast areas is now available. Darryll Olsen, Ph.D., of the Pacific Northwest Project, a regional planning/resource economics firm, and Jack Richards, Ph.D., Department of Economics, Portland State University, produced the report under a contract with the Corps of Engineers.

Olsen and Richards conducted a review of current information on the extent and range of salmon stocks along the West Coast, salmon production goals, and the relationship between ocean conditions, in-river conditions and salmon production. They found ample evidence that there is support in the scientific community for a hypothesis on ocean effects on salmon.

The data indicates climatic changes as well as ocean factors likely affect physical, biological and chemical processes that in turn affect salmon populations. Olsen/Richards report, for example, that "prevailing winds drive surface waters offshore from the Pacific Coast (Southern Canada, US, and Mexico) causing deeper, nutrient transporting water to 'upwell' to the surface. This nutrient-rich water stimulates plankton growth that in turn supports a foodchain vital to Pacific salmon."

A 1992 study by Doctor William Pearcy of Oregon State University indicates that periods of high temperatures and low pressures in the Northeastern Pacific Ocean since 1977 have had positive effects for salmon in the Gulf of Alaska region but negative effects in the California Current.

Pearcy and others report that El Nino in 1982-1983 and in the early 1990s brought warm surface waters and wind changes to the Pacific Coast that have suppressed the normal "upwelling" so that not enough nutrients surfaced to sustain past numbers of salmon. During the '82-83 El Nino event, plankton was reduced to less than a third of the level in non-El Nino years; very low coho salmon numbers were recorded.

The Olsen/Richards study looks at escapement goals and performance to examine trends in adult returns. Escapement refers to the number of adults that successfully return to spawn. The goals, set by resource management agencies, are meant to help achieve sustainable runs. Data indicate that several West Coast river basins were able to achieve relatively high percentages of their escapement goals during the 1985-1989 period, but were not very successful in the early 1980s and 1990s.

The report cites a Cooper and Johnson study for Washington Department of Wildlife that compared Washington steelhead trends with Oregon and British Columbia trends. The 1992 report concludes:

"Similarities in overall trends and year-to-year trends of steelhead abundance in widely separated geographical areas strongly indicate that common factors are responsible for the recent decline in steelhead abundance along the Pacific Coast. . . Similarities in survival trends . . . strongly indicate that oceanic conditions are primarily responsible."

Olsen and Richards also examined empirical data on salmon returns. They looked at Snake River spring chinook returns at Lower Granite Dam. These fish are a good indicator stock since there is limited harvest in the ocean or in-river but the fish must negotiate the eight lower Columbia and Snake River Dams in their migrations.

Returns of the Snake River spring chinook were compared to West Coast coastal chinook production and to West Coast river basin chinook production. In both cases, similar overall and year-to-year trends suggested that similar factors were at work that cannot be traced to harvest levels or in-river conditions. The downward trends reflect periods of observed poor ocean conditions or El Nino events.

The report concludes that information on ocean conditions, status of salmon stocks, and salmon production trends in coastal and inter-basin areas strongly supports the hypothesis that ocean and climatic conditions have had a "marked impact on Columbia River and other coastal basin salmon production." In general, the production trends for various runs of salmon reflect periods of poor ocean conditions or El Nino events.

This hypothesis, if accepted, needs to be considered when drawing conclusions about the effects of past actions and making decisions about future actions for salmon in the freshwater habitat. However, gaining an appreciation for the extent that ocean ecological conditions can influence production trends will not reduce the Corp's obligation or intent to continue to take actions in the river habitat for achieving salmon recovery.

For a copy of the study contact:
Frank McDonald, CENPD-PE-EC, P.O. Box 2870, Portland OR 97208-2870, phone 503-326-3872.

ENDANGERED SPECIES ACT LISTINGS

Snake River Chinook status downgraded

Two populations of Snake River chinook salmon, which returned in alarmingly low numbers this year, are considered at risk of extinction. The spring/summer and fall chinook salmon species were reclassified as endangered under the Endangered Species Act August 18 by the National Marine Fisheries Service, based on a projected decline in adult Snake River chinook salmon abundance.

The emergency action will remain in effect until May 26, 1995, when the fisheries agency will publish a rule proposing to make the classification permanent and provide an opportunity for public comment on the proposal. Snake River chinook had been classified as threatened since May 1992.

Mid-Columbia Chinook Okay for Now

The Fisheries Service decided not to list the mid-Columbia summer chinook salmon for protection under the Act—concluding that the fish is a part of a larger non-listed group that includes all late-run chinook from the mainstem Columbia.

The Fisheries Service indicates that the mid-Columbia salmon should benefit from actions taken to protect listed Snake River salmon in the same area, including increased flows and ocean harvest restrictions.

Continued on page 6.

SYSTEM CONFIGURATION STUDY ENTERS PHASE II

The System Configuration Study Phase I report is nearing completion, and Phase II activities have begun. Since the July 15 close of public comment period on the Phase I report, the Corps has reviewed comments and discussed options with regional agencies and interests.

The report provided findings on the technical feasibility, economic and environmental impacts, costs, and construction schedules for several alternative ways to reconfigure the federal projects on the lower Columbia and Snake rivers to improve salmon migration conditions.

The Corps is recommending that several of the major Phase I alternatives should continue into further analysis in Phase II. One is the option for a new upstream storage project in the upper Snake River Basin to provide additional water for flow augmentation during salmon migrations. Natural river level drawdown of the four lower Snake River reservoirs is proposed for expanded study to look at year-round natural river options (see related story.) Many of the system improvements in Phase I would be retained, with expedited evaluation and implementation. Study of netpens for short-haul barging and for acclimation of hatchery fish is recommended.

The Corps has already begun preparing for tests of surface-oriented bypass systems for the lower Columbia and Snake River dams (see related story). Gas abatement at the projects is another focus, with a goal to find ways to allow more spilling of water and fish at the dams without the high levels of gas supersaturation now generated with high spill.

The Corps recommends delaying further study on upstream collectors and spillway crest drawdown of the lower Snake River reservoirs, until such time as changes in level of technology or biological information increase their appeal.

The Corps suggests study of John Day Dam operation at Minimum Operating Pool level be discontinued because of low expectations for any improvement in salmon survival from such an operation. However, advance planning and design on necessary dam modifications continues while we await regional feedback on this recommendation.

Also on the list of recommended deletions are pipelines—including the floating in-river pipeline—and canals for conveying juvenile salmon to the ocean. The study team points to biological uncertainties with these untested and highly complex mechanical systems.

BIOLOGICAL DRAWDOWN TEST PREPARATIONS CURTAILED

Based on review of the latest available scientific information and comments received on the *Lower Snake River Biological Drawdown Test Draft Environmental Impact Statement* (EIS), the Corps has curtailed preparations for a 1996 biological drawdown test at Lower Granite Reservoir.

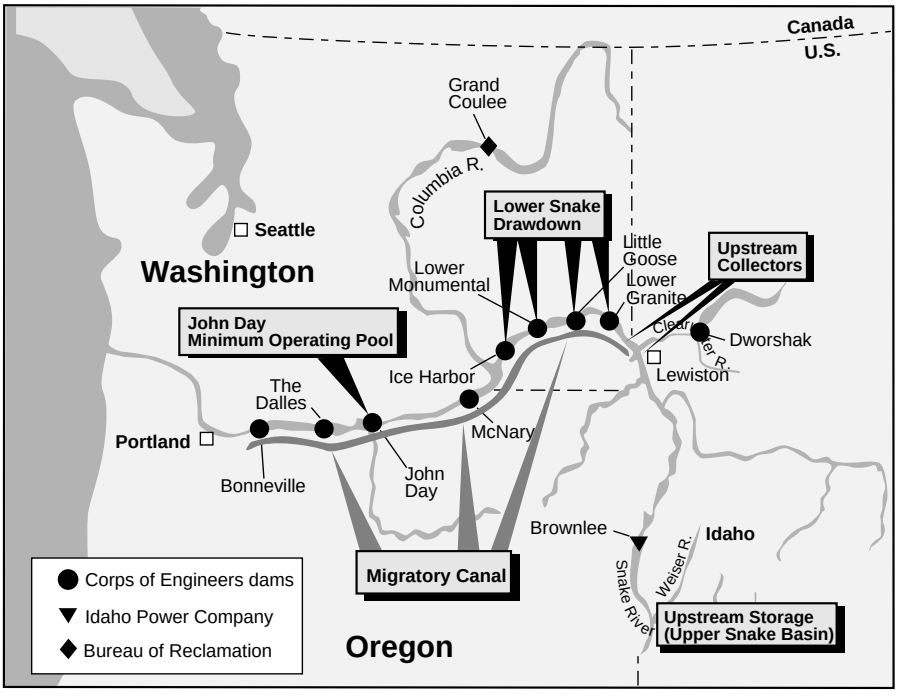
In the draft EIS released in April, the Corps and National Marine Fisheries Service identified a two-month long spring drawdown test as the preferred alternative among an array of alternatives for a drawdown test at Lower Granite Dam. The agencies had hoped to gain information on the biological effects of drawdown on salmon migrating through the reservoir.

Preliminary findings from ongoing studies and data collection over the last two years by scientists of the National Marine Fisheries Service and the University of Washington School of Fisheries Center for Quantitative Science indicate that juvenile salmon migrating through Lower Granite reservoir experience a much higher survival rate than originally thought—in excess of 90 percent.

The research findings will influence decisions on biological drawdown test alternatives in the final EIS expected in January 1995. As proposed, the test alternatives would not be able to provide useful information on improvements in juvenile fish survival during drawdown of Lower Granite Reservoir. If juvenile survival is already high through the reservoir, there would be insufficient change resulting from a drawdown test at Lower Granite to make meaningful statistical inferences.

The proposed test was studied in response to regional requests to move forward with evaluation of the drawdown concept. Lower Granite is the first federal reservoir encountered by juvenile salmon migrating downstream from Idaho.

Analysis of reservoir drawdowns as a salmon restoration measure continues in regional studies such as the Corps System Configuration Study and the multi-agency Columbia River System Operation Review.



SCS alternatives evaluated in Phase I.

Continued from page 4.

Kootenai River White Sturgeon listed

The U.S. Fish and Wildlife Service listed the Kootenai River white sturgeon as endangered September 6.

The Kootenai River population of white sturgeon is restricted to approximately 168 miles in the Kootenai River, from upstream of Cora Linn Dam in British Columbia to Kootenai Falls, 31 miles below Libby Dam in Montana. This population is considered genetically distinct, and has been reproductively isolated from other white sturgeon populations in the Columbia River basin for approximately 10,000 years.

The free-flowing river habitat considered necessary for successful sturgeon spawning has been affected by development of the Kootenai River basin. Operation of Libby Dam for hydropower and flood control has reduced river flows during the May to July spawning season. The population also faces threats from reduced biological productivity, predation, and effects of contaminants in the river system.

The Corps and Bonneville Power Administration have worked with the Fish and Wildlife Service, Idaho, Montana and the Kootenai Tribe over the past two years in an effort to test various flow regimes in the Kootenai. These efforts were aimed at inducing spawning and natural recruitment of the sturgeon. Spawning has occurred, but the more difficult task of documenting recruitment of juvenile sturgeon into the population has been less conclusive.

Salmon Passage Notes is published by the North Pacific Division of the U.S. Army Corps of Engineers.

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Editor, Salmon Passage Notes
Public Affairs Office
North Pacific Division
U.S. Army Corps of Engineers
Box 2870 Portland, OR 97208-2870
FAX (503) 326-5523